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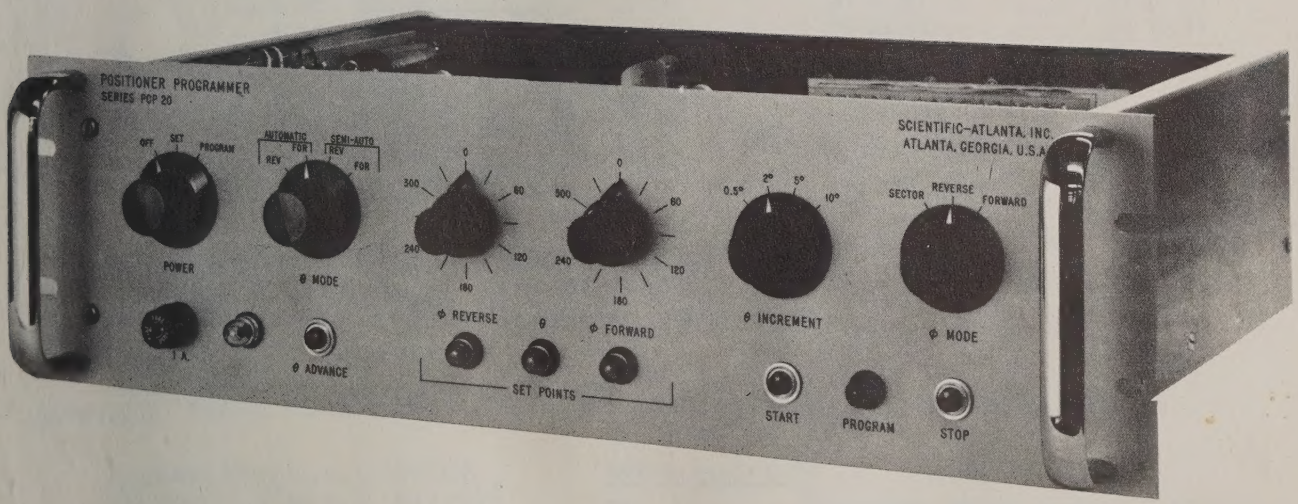
MODEL NO. _____

SERIAL NO. _____

CALIBRATION LAB ESSD

INSTRUCTION MANUAL

MODEL PCP-2004
POSITIONER PROGRAMMER



First Edition
March 1963

Price $2

INSTRUCTION MANUAL
CHANGE NOTICE

MODEL PCP-2004, FIRST EDITION, MARCH 1963

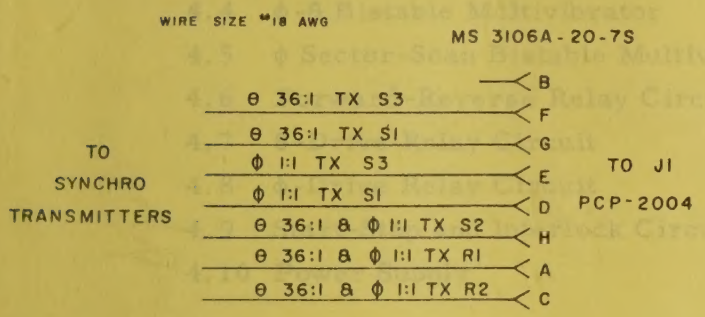
To make this manual apply to your instrument, make the manual changes shown below.

Instrument Serial No.	Change	Instrument Serial No.	Change
16 and up	1		
60 and up	2		

NOTE: This manual is applicable to Models 2004 and PCP-2004, which are identical except for nomenclature.

Change 1: Make the following synchro-wiring changes to the last two diagrams at the back of the manual:

Synchro-Input Cable



Schematic Diagram

-change-

(on B1)	(on B2)
S1 to S3	S1 to S2
S2 to S1	S2 to S3
S3 to S2	S3 to S1

Synchro-Input Cable: Note that the S2 and S1 terminals of synchro B2 are connected to the S2 and S3 terminals, respectively, of the ϕ-1:1 synchro transmitter.

Change 2: Series RC circuits have been placed across five relay contacts as follows:

Contact K1A (n.o.): R9-C8
Contact K1B (n.o.): R11-C10
Contact K2B (n.o.): R10-C9
Contact K2C (n.o.): R8-C7
Contact K3B (n.o.): R12-C11

Add to page 6-2:

C7 C8	Capacitor, fixed, Mylar, 0.1 μf, 100v; CD; WMF1P1
C9 C10 C11	Capacitor, fixed, Mylar, 0.1 μf, 400v; CD; WMF4P1

Add to page 6-5:

R8 thru R12	Resistor, fixed, composition, 22 ohms ±10%, 1/2w; O; LD

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SECTION 1
GENERAL DESCRIPTION

1.1 Introduction

The Scientific-Atlanta Model PCP-2004 Positioner Programmer, intended for use with a Scientific-Atlanta Model PC-4A Positioner Control Unit or PC-4D Dual-Channel Positioner Control Unit, offers completely automatic operation of Scientific-Atlanta two-axis antenna positioners having a 1:1 synchro system in the ϕ (azimuth) axis and a 36:1 synchro system in the θ (elevation) axis.

A programmed scan over the sphere of radiation of an antenna, missile, or scale model of an airframe can be made with the Model PCP-2004. The operator-selectable θ increments are 0.5°, 2°, 5°, and 10°. The 0.5° and 2° increments, combined with the ϕ rotation of 360° or an adjustable sector of up to 350°, allow plots of radiation distribution to be made when the Model PCP-2004 is used in conjunction with a Scientific-Atlanta Model RDP-1801 Radiation Distribution Printer.

Programming of positioner motions releases the operator from tedious repetitive operations. Also, it significantly reduces the time required for plotting a series of radiation patterns, for completing the table of radiation distribution produced by the Model RDP-1801, or for integrating over a sphere with a Scientific-Atlanta three-dimensional antenna pattern integrator.

1.2 Principles of Operation

As is shown in Fig. 1.1, signals from a 1:1 synchro on the ϕ axis of the positioner are fed to a synchro receiver in the programmer. Two opaque arms, geared at a 1:1 ratio to the synchro receiver, experience an angular displacement identical to that of the positioner about the ϕ axis. At a ϕ forward or ϕ reverse set point an arm will interrupt the light shining on one of two phototransistors. These phototransistors are connected to Schmitt circuits which generate a trigger when a ϕ set point is reached. The limits established by the phototransistors are adjustable by means of front-panel controls. When the 360° ϕ scan is employed, changeover to the θ axis occurs when the reverse ϕ set point is reached when scanning in the reverse direction or when the forward ϕ set point is reached when scanning in the forward direction.

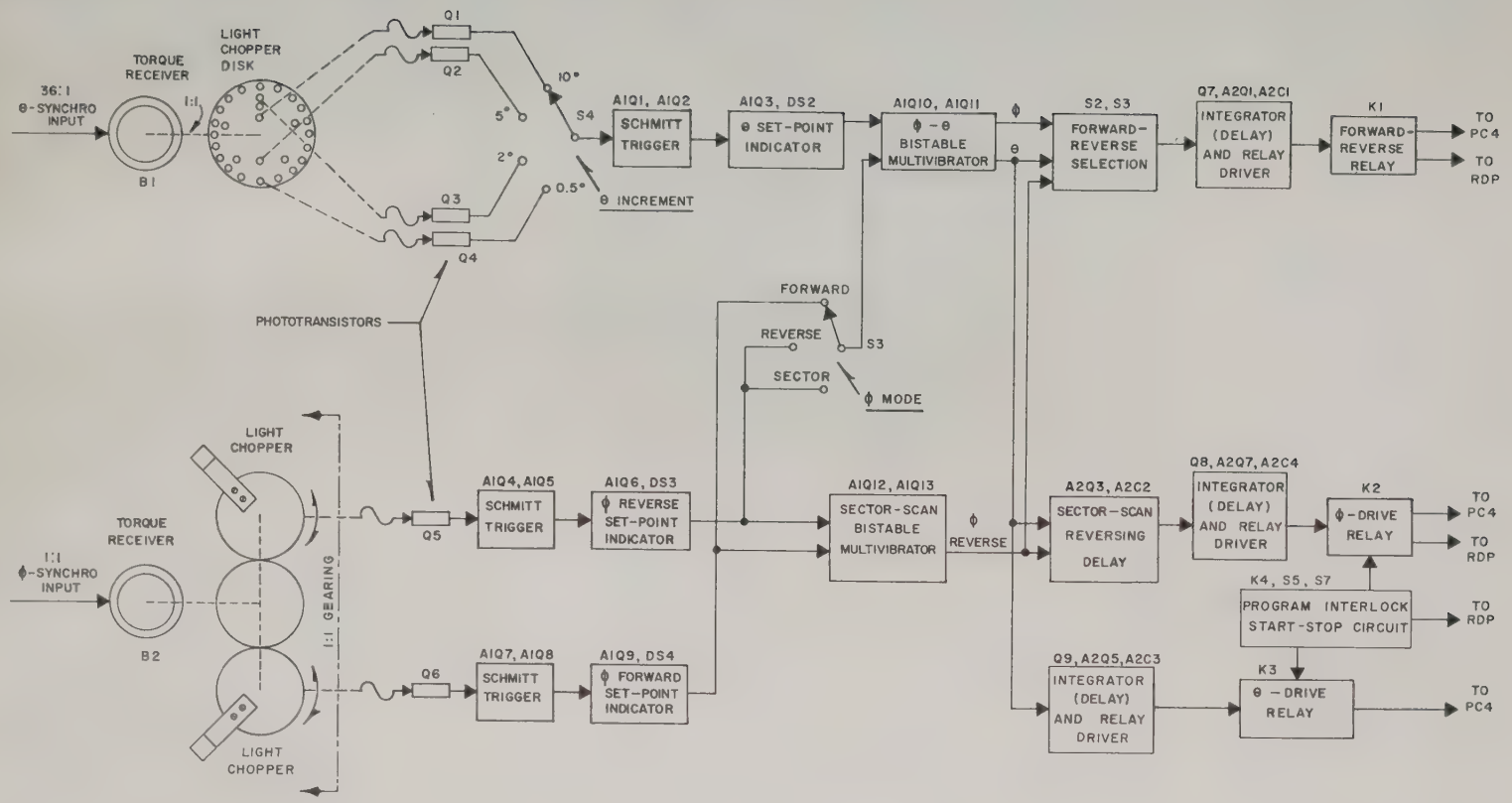


Fig. 1.1 Block Diagram of Model PCP-2004 Positioner Programmer

Signals from a 36:1 synchro on the θ axis are fed to a synchro receiver. A light-chopper disk with a separate track and phototransistor for each θ increment is mounted on the synchro shaft. A θ-increment switch connects the appropriate phototransistor to a Schmitt circuit which generates triggers at the increment selected. The output of this circuit and the Schmitt circuits operated at the forward and reverse ϕ set points are connected to a logic circuit which programs operation of the positioner control unit associated with the programmer.

The programmer, when connected to a Series PC-4 Positioner Control Unit, operates a forward-reverse relay and contactors which apply power to the ϕ-axis drive motor and the θ-axis drive motor. The positioner control unit supplies 105 volts dc for the field windings and a continuously variable voltage (0-120 volts dc) for the armatures of the drive motors. The Model PC-4D is recommended for use wherever it is desired to step 0.5° or 2° in θ at a slow positioner speed and to ϕ scan at a relatively high positioner speed; the Model PC-4A has the flexibility of being able to switch control to six axes when operated manually.

When the Model PCP-2004 is used in a system that incorporates a Scientific-Atlanta Model RDP-1801 Radiation Distribution Printer, it provides control signals to initiate typing at the beginning of each writing line. An interlock is provided to stop the program if the normal typing speed of the radiation distribution printer is exceeded or if the positioner does not stop within preset limits upon completion of each 360° ϕ scan.

1.3 Specifications

Number of Programmed Coordinates	Two
ϕ-Axis Program	Forward or reverse 360° scan, with adjustable starting point. Sector scan, with forward and reverse limits adjustable for any included angle of up to 350°
θ-Axis Program	Change of 0.5°, 2°, 5°, or 10° in θ upon completion of each ϕ scan.
Synchro Input	From 115/90v, 60-cps, 36:1 synchro on elevation axis and 1:1 synchro on azimuth axis

Output	Relay closures to Model PC-4A or PC-4D Positioner Control Unit and Model RDP-1801 Radiation Distribution Printer
Additional Equipment Required	Model PC-4A Positioner Control Unit or Model PC-4D Dual-Channel Positioner Control Unit
Dimensions	5-1/4 inches high; mounts in standard 19-inch RETMA-type equipment rack

SECTION 2
INSTALLATION

The Scientific-Atlanta Model PCP-2004 Positioner Programmer is designed to drive either a Model PC-4A Positioner Control Unit or a Model PC-4D Dual-Channel Positioner Control Unit. If a Model PC-4A Positioner Control Unit is used, connect J3 of the programmer to J2 of the Model PC-4A. If a Model PC-4D Dual-Channel Positioner Control Unit is used, connect J4 of the programmer to J6 of the Model PC-4D.

All connections to the positioner programmer are made through type MS connectors located on the rear of the chassis. Refer to the schematic and cable diagrams at the rear of this manual for cable information. Fig. 2.1 shows the cabling to the programmer.

The positioner programmer operates the positioner control unit to generate either ϕ (azimuth) sector scans or 360° ϕ scans followed by a change in θ (elevation). If a Model PC-4A Positioner Control Unit is used, the axis marked AZ-1 normally is defined as the ϕ axis and the axis marked EL-1 normally is defined as the θ axis. The cable connecting the Model PC-4A to the antenna positioner should be wired so that the axis about which antenna pattern cuts are taken, the ϕ axis, is connected to the Model PC-4A outputs marked AZ-1 and the θ axis is connected to the outputs marked EL-1. Refer to the Model PC-4A instruction manual for additional information.

If a Model PC-4D Dual-Channel Positioner Control Unit is used and connected to the programmer by a standard cable, the positioner axis connected to J5 of the control unit, the azimuth channel, is defined as the ϕ axis, and the positioner axis connected to J2, the elevation channel, is defined as the θ axis. The positioner axes can be changed by interchanging the cables to J2 and J5 of the Model PC-4D or by interchanging the ϕ and θ functions in the cable connecting J4 of the programmer to J6 of the Model PC-4D.

The programmer must be connected to a synchro transmitter geared at a 1:1 ratio to the ϕ axis and to a synchro transmitter geared at a 36:1 ratio to the θ axis. These synchro inputs must be connected to J1 on the rear of the chassis. Pin connections are shown on the schematic diagram at the rear of this manual. Note

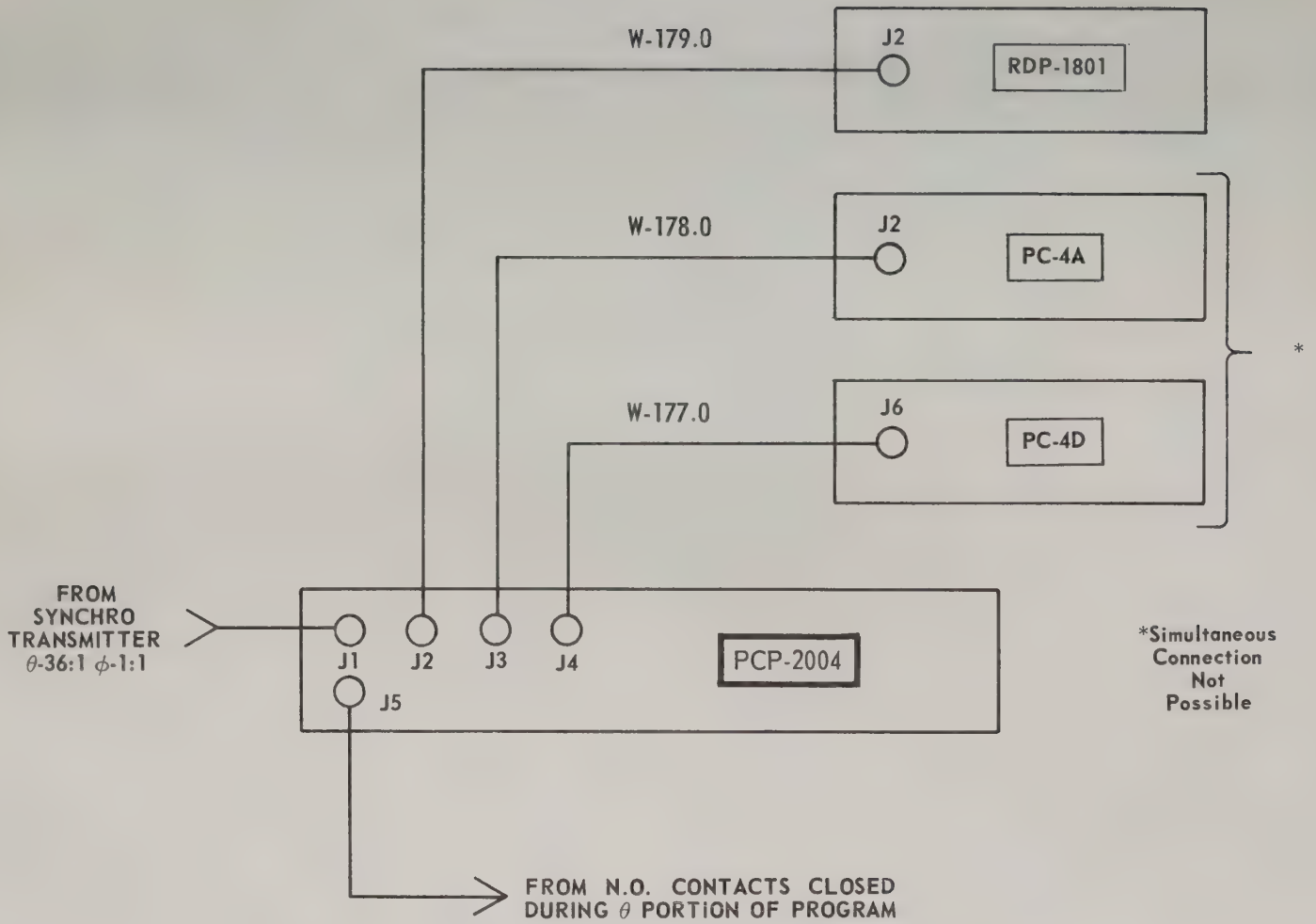


Fig. 2.1 Cable Connections to PCP-2004 Programmer

that the stator leads connecting to S1 and S3 of the ϕ-axis synchro receiver are reversed; S1 of the synchro transmitter connects to S3 of the synchro receiver and S3 of the synchro transmitter connects to S1 of the synchro receiver. The rotor voltage must be supplied from the same source which excites the synchro transmitters. The rotor voltage is also used as ac power for the positioner programmer.

If the positioner programmer is used in a system incorporating a Scientific-Atlanta radiation distribution printer, connect J2 of the programmer to J2 of the radiation distribution printer and remove the jumper from TB1 in the programmer. (This jumper must be installed when the radiation distribution printer is not connected to J2.)

The normally open C contacts of relay K3 are connected to J5, and close during the θ portion of the programmed cycle. These contacts may be utilized to control an auxiliary function if desired; the contacts are rated at 5 amperes.

SECTION 3
OPERATION

The Model PCP-2004 programs a positioner control unit to provide either forward or reverse 360° ϕ scans or ϕ sector scans. Upon completion of each 360° ϕ scan or each sector-scan cycle, power is transferred to the θ axis and a change of 0.5°, 2°, 5°, or 10° is made. Power is then transferred back to the ϕ axis and another cycle of operation is begun. The ϕ sector-scan limits and the point at which the θ changeover occurs are determined by the settings of the ϕ FORWARD and ϕ REVERSE controls.

The forward direction is defined as that direction of rotation of a positioner axis which produces clockwise position indicator rotation. Forward positioner movement causes the ϕ set-point detector synchro to rotate counterclockwise; forward θ movement rotates the θ-increment detector synchro clockwise.

For programmed operation the REMOTE OR PCP - LOCAL switch on the Model PC-4A Positioner Control Unit must be in the REMOTE OR PCP position and the axis selector switch in the LOCAL OR PCP position.

If a Model PC-4D Dual-Channel Positioner Control Unit is used, no special control settings are required for programmed operation. The θ (elevation) SPEED CONTROL setting should be as low as practicable for best accuracy.

Front-Panel Controls and Indicators (See Fig. 3.1)

POWER Switch--Controls power to the positioner programmer and selects manual or programmed operation. When this switch is in the OFF position, ac power input is not applied; in the SET position, the SET POINT indicator lights are operable as an aid to setting the ϕ FORWARD and ϕ REVERSE set points or as an aid to bringing the positioner to the proper orientation for beginning the program; in the OFF or SET position, the positioner control unit can be operated manually; in the PROGRAM position, the positioner control unit is controlled by the positioner programmer.

θ MODE Switch--Controls the θ drive direction and selects automatic or semi-automatic θ advancement. When the switch is set to AUTOMATIC, power is

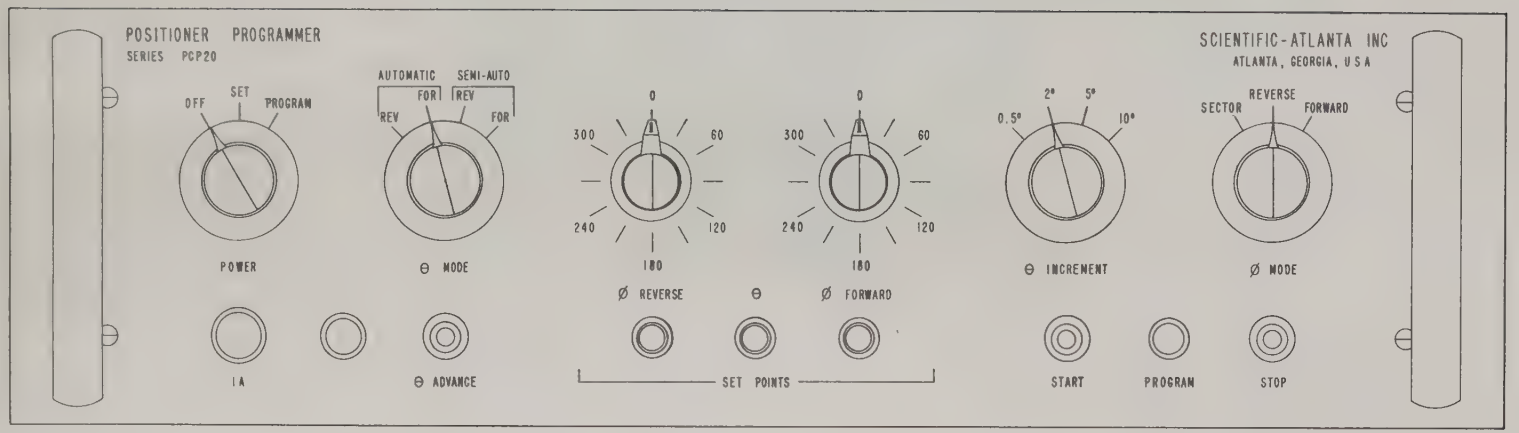


Fig. 3.1. Front Panel of Model PCP-2004 Positioner Programmer

transferred automatically to the θ axis upon completion of each 360° ϕ scan or each ϕ sector-scan cycle, a change in θ equal to that selected by the θ INCREMENT switch is made, power is transferred back to the ϕ axis, and programmed operation continues until a positioner limit is reached or the STOP pushbutton is pressed. When the switch is set to SEMI-AUTO, the program is interrupted at the end of each 360° ϕ scan or each ϕ sector-scan cycle; the positioner is advanced in θ by pressing the θ ADVANCE pushbutton, which must be held depressed until drive power has been transferred back to the ϕ axis. When the switch is in a FOR position, the positioner advances in θ in the forward direction. When the switch is in a REV position, the positioner advances in θ in the reverse direction.

ϕ REVERSE SET POINT Control--Determines the point at which the θ changeover occurs when making ϕ scans in the reverse direction or when making ϕ sector scans.

ϕ REVERSE SET POINT Indicator Light--Illuminates when the positioner reaches the point set by the ϕ REVERSE SET POINT control.

ϕ FORWARD SET POINT Control--Determines the point at which the θ changeover occurs when making ϕ scans in the forward direction, and controls the forward limit when making ϕ sector scans.

ϕ FORWARD SET POINT Indicator Light--Illuminates when the positioner reaches the point set by the ϕ FORWARD SET POINT control.

θ INCREMENT Switch--Selects the amount that the positioner will advance in θ between successive ϕ scans.

θ SET POINT Indicator Light--Illuminates when the positioner reaches an increment set by the θ INCREMENT switch.

ϕ MODE Switch--Selects either 360° ϕ scans or ϕ sector scans. During ϕ sector scans, the reverse and forward sector limits are set by the ϕ REVERSE and ϕ FORWARD SET POINT controls, respectively; the θ changeover occurs when the ϕ reverse set point is reached. When the switch is in the REVERSE position, 360° ϕ scans are made in the reverse direction and the θ changeover occurs when

the ϕ reverse set point is reached. When the switch is in the FORWARD position, 360° ϕ scans are made in the forward direction and the θ changeover occurs when the ϕ forward set point is reached.

PROGRAM (START - STOP) Pushbuttons--Initiate and terminate the program. When the START pushbutton is pressed for the first time after the POWER switch is placed in the PROGRAM position, ϕ scanning starts in the direction selected by the ϕ MODE switch. If the ϕ MODE switch is in the SECTOR position, the ϕ scan begins in the forward direction. When the STOP pushbutton is pressed, the program stops. When the START pushbutton is pressed again, the program will revert to the state in which it was before the STOP pushbutton was pressed. If the POWER switch is changed to SET and then back to the PROGRAM position, the program will start in the ϕ mode when the START pushbutton is pressed.

PROGRAM Indicator Light--Illuminates when the program is in operation.

SECTION 4
DETAILED DESCRIPTION

The principles of operation of the programmer have been described briefly in a previous section; in this section the various circuits involved are discussed in greater technical detail. In following these discussions, one should refer to the schematic diagram at the rear of this manual and to the block diagram in Section 1.

Fig. 4.1 is a timing diagram of the programmer which illustrates the action taking place during one cycle of automatic 10°-forward-θ operation with the ϕ axis programmed for scanning a sector. This figure shows the occurrence of switching functions in time relationship to each other but is not to exact scale. Slight overshoots in ϕ and θ movements may occur at the higher positioner speeds, but are not shown on the diagram.

The programmer is composed of one chassis upon which are mounted several subassemblies. The ϕ set-point detector is located in the center of the chassis and the θ-increment detector is located at the left side of the chassis.

Two plug-in cards, located at the right side of the chassis, contain most of the components associated with the Schmitt triggers, bistable multivibrators, and integrators. The cards are identified by a number (A1 or A2) stamped on their bases. This number is used as a prefix in the text of this section to identify the particular component that is mentioned. For example, capacitor A2C2 is located on card A2. A component not carrying such a prefix (for example, C2 or R7) is located on the main chassis or on the front panel.

The four plug-in relays used in the programmer are located near the rear of the chassis at the right side. Relays K2 and K3 are interchangeable, as are K1 and K4.

4.1 Operating Functions

The Model PCP-2004 Positioner Programmer operates a Scientific-Atlanta Model PC-4A or PC-4D Positioner Control Unit through the operation of relays and switching circuits in the programmer. The ϕ- and θ-drive relays (K2 and K3)

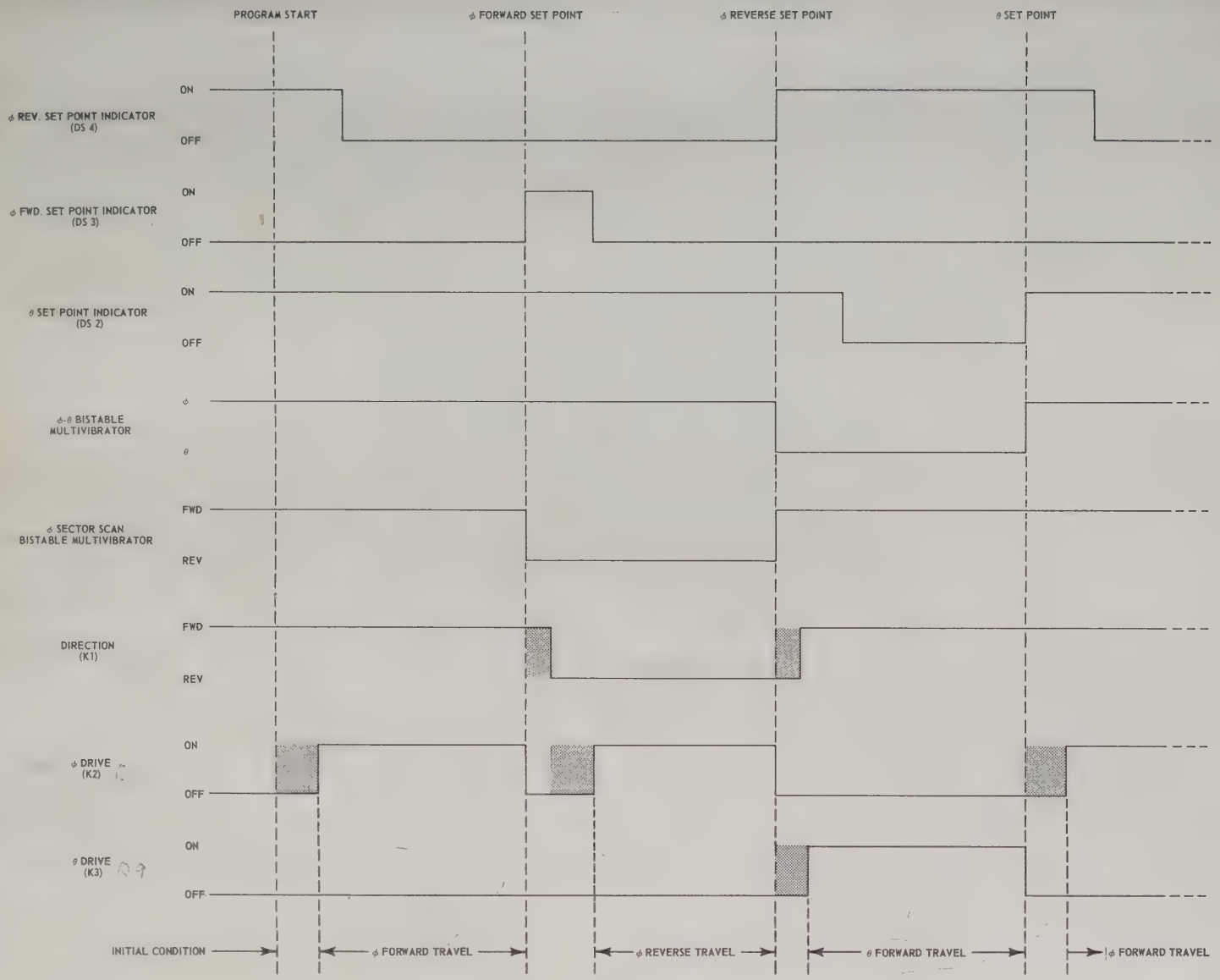


Fig. 4.1 Diagram Showing Sequence of Events During Automatic Forward-θ Operation With φ Axis Programmed for Sector Scan. The Shaded Areas Represent a Time Delay in Relay Operation

in the positioner programmer are connected to the contactors in the armature circuits of the positioner control unit which supply power to the ϕ (azimuth) and θ (elevation) drive motors in the antenna positioner. When operating in a programmed mode, energization of ϕ-drive relay K2 causes the contactor in the armature circuit to be energized and power to be applied to the armature of the ϕ drive motor. When K2 is de-energized, the contactor is released and connects the armature of the ϕ drive motor to a resistor for dynamic braking. θ-drive relay K3 controls power to the θ drive motor in a similar manner.

The direction of rotation of the ϕ and θ drive motors is determined by the polarity of the voltage fed to the armatures of the drive motors. Forward-reverse relay K1 in the positioner programmer is connected to a contactor in the PC-4A positioner control unit which reverses the polarity of the armature power supply. When K1 is energized, the ϕ or θ drive motor, depending upon which is connected to the armature supply, will run to drive the positioner in the reverse direction.

Relay K1 switches the polarity of only the ϕ armature supply in the PC-4D Positioner Control Unit. The polarity of the θ armature supply is controlled by θ MODE switch S2.

The positioner control unit can be operated manually when the programmer POWER switch (S1) is in the OFF or SET position. In either of these positions, switch contacts S1E are open causing the local-remote relay (K1) in the PC-4A to be de-energized to allow operation of the positioner control unit directly.

Switch contacts S1F and S1G are closed when in the OFF or SET position to allow the armature contactors in the PC-4D to be operated directly from that unit's front-panel controls.

4.2 ϕ Set-Point Detector

The orientation of the antenna positioner about the ϕ axis is determined from synchro information received from a synchro transmitter geared at a 1:1 ratio to the positioner ϕ axis. This synchro transmitter is connected to synchro receiver B2 in the positioner programmer; the S1 and S3 stator leads are interchanged. The synchro receiver is geared at a 1:1 ratio to two counter-rotating

gears. The ϕ SET POINT controls on the front panel of the programmer rotate a phototransistor and lamp assembly around the periphery of both of the counter-rotating gears. A shadow arm is connected to each of the counter-rotating gears. The shadow arm on the forward-rotating (right-hand) gear interrupts the light to phototransistor Q6 at the ϕ-FORWARD set point; the shadow arm on the reverse-rotating (left-hand) gear interrupts the light to phototransistor Q5 at the ϕ-REVERSE set point. Interruption of light to Q6 causes ϕ FORWARD SET POINT indicator DS4 to turn on. Interruption of light to Q5 causes ϕ REVERSE SET POINT indicator DS3 to turn on. Triggers derived from across these indicator lights switch the ϕ-θ (paragraph 4.4) and ϕ-sector-scan bistable multivibrators (paragraph 4.5).

Phototransistor Q6 is connected to the input of a Schmitt trigger circuit composed of transistors A1Q7 and A1Q8. When light is interrupted to Q6 at the ϕ-forward set point, transistor A1Q7 conducts, cutting off A1Q8 and switching on A1Q9 to turn on ϕ FORWARD SET POINT indicator DS4. The voltage to DS4 is reduced by A1R47 to prevent the light from being unnecessarily bright and to increase lamp life. The switching current of A1Q9 is reduced by shunting part of the current through A1R31.

A similar circuit is provided for turning on ϕ REVERSE SET POINT indicator light DS3. Phototransistor Q5 is connected to a Schmitt trigger circuit, composed of transistors A1Q4 and A1Q5, which switches on A1Q6 to turn on DS3.

4.3 θ-Increment Detector

The orientation of the antenna about the θ axis is determined from synchro information received from a synchro transmitter geared at a 36:1 ratio to the positioner θ axis. This synchro transmitter is connected directly to torque receiver B1 in the positioner programmer. A light-chopper disk is mounted on the rotor of B1. Four lamps are mounted on one side of the disk, and four phototransistors (Q1 through Q4) are mounted on the other side of the disk. Holes are located around the light-chopper disk at angular increments corresponding to 0.5°, 2°, 5°, and 10° in θ. One of the phototransistors is connected to the input of the Schmitt trigger circuit, composed of transistors A1Q1 and A1Q2, for each position of θ INCREMENT switch S4. When light falls on the phototransistor selected by S4, A1Q1 will conduct and cut off A1Q2. Transistor A1Q3 is switched on to light θ SET POINT indicator lamp DS2.

4.4 ϕ-θ Bistable Multivibrator

The ϕ-θ bistable multivibrator, composed of transistors A1Q10 and A1Q11, determines whether power will be applied to the ϕ or the θ drive motor. Transistor A1Q10 is cut off and A1Q11 is conducting when in the ϕ state; A1Q10 is conducting and A1Q11 is cut off when in the θ state. The output of the multivibrator is taken from the collectors of A1Q10 and A1Q11.

The ϕ-θ bistable multivibrator is switched to the ϕ state when the POWER switch is in the SET position. When the POWER switch is switched from SET to PROGRAM and the START button pressed, the program will start in the ϕ mode. If the program is interrupted and restarted by pressing the STOP and then the START button, the program will resume in the mode in which it was when interrupted.

The ϕ-θ bistable multivibrator is switched from the ϕ state to the θ state by a positive trigger fed through A1CR2. This trigger is obtained from the θ-forward set-point indicator circuit when ϕ MODE switch S3 is in the FORWARD position, and is obtained from the ϕ-reverse set-point indicator circuit when S3 is in the REVERSE or SECTOR position. The trigger is obtained by differentiating the positive-going pulse appearing at the collector of A1Q6 or A1Q9. Capacitor A1C3 and resistor A1R32 form the differentiating circuit for the θ-forward set point, and A1C2 and A1R30 form the differentiating circuit for the ϕ-reverse set point.

The ϕ-θ bistable multivibrator is switched from the θ state to the ϕ state by a positive trigger fed through A1CR1. This trigger is obtained from the θ-set-point indicator circuit by differentiating the positive-going pulse appearing at the collector of A1Q3 by A1C1 and A1R28.

A reverse bias of approximately -5.5 volts, obtained by returning the differentiating resistors to the negative supply through A1R50, A1R51, and A1R52, is applied to trigger diodes A1CR1 and A1CR2 to prevent power-supply transients from being coupled through and triggering the ϕ-θ bistable multivibrator. Additional protection against triggering by noise is achieved by connecting capacitor A1C4 between the bases of the multivibrator transistors.

4.5 ϕ Sector-Scan Bistable Multivibrator

The ϕ sector-scan bistable multivibrator, composed of transistors A1Q12 and A1Q13, controls operation of the forward-reverse relay circuit when operating in the sector-scan mode. Transistor A1Q12 is cut off and A1Q13 is conducting when in the ϕ-forward state; A1Q12 is conducting and A1Q13 is cut off when in the ϕ-reverse state. This multivibrator is similar to the ϕ-θ bistable multivibrator discussed in paragraph 4.4.

The ϕ sector-scan bistable multivibrator is switched to the ϕ-forward state when the POWER switch is in the SET position. When the POWER switch is switched from SET to PROGRAM and the START button pressed, the program will start in the ϕ-forward direction when in the sector-scan mode. The multivibrator is switched to the ϕ-reverse state when the ϕ-forward set point is reached by a positive trigger coupled through trigger diode A1CR3. The bistable multivibrator is switched from the ϕ-reverse state to the ϕ-forward state when the ϕ-reverse set point is reached by a positive trigger coupled through trigger diode A1CR4. The output is taken from the collector of A1Q13.

4.6 Forward-Reverse Relay Circuit

The normally open B contacts of forward-reverse relay K1 are connected to forward-reverse relays K2 and K6 in the PC-4A Positioner Control Unit when operating in a programmed mode. Energization of K1 causes K2 in the positioner control unit to be energized, reversing the polarity of the armature supply voltage for reverse rotation of either the ϕ or θ drive motor. Relay K6 in the positioner control unit switches to the positioner forward limit switches when rotation of either the ϕ or θ drive motor is in the forward direction, and switches to the positioner reverse limit switches when rotation is in the reverse direction.

The normally open B contacts of the forward-reverse relay are connected to forward-reverse relays K4 and K5 in the PC-4D Positioner Control Unit when operating in a programmed mode. Energization of K4 in the positioner control unit causes rotation of the ϕ (azimuth) drive motor to be in the reverse direction. Relay K5 switches between the ϕ-forward (azimuth cw) limit switch and the ϕ-reverse (azimuth ccw) limit switch. The θ (elevation) drive motor is caused to rotate in the reverse direction when the C contacts of θ MODE switch S2 are closed and when operating in a programmed mode.

When the ϕ-θ bistable multivibrator is in the θ state and the θ MODE switch is in a REV position, the negative voltage appearing on the collector of A1Q11 will be fed through A1CR5 and switch contacts S2A to cause forward-reverse relay K1 to be energized. A time delay is provided by an integrating network (A2C1, A2R7, and A2R8) to allow the contactors connecting the armature power supply to the drive motors to be de-energized before reversing the polarity of the armature supply voltage. After the time delay, transistor A2Q1 conducts to switch on relay driver Q7 which energizes K1.

When the ϕ-θ bistable is in the ϕ state and the ϕ MODE switch is in the REVERSE position, the negative voltage appearing on the collector of A1Q10 will be fed through switch contacts S3A and diode A2CR1 to cause forward-reverse relay K1 to be energized. When the ϕ MODE switch is in the SECTOR position and the ϕ sector-scan bistable multivibrator is in the reverse state, the negative voltage appearing on the collector of A1Q13 is fed through switch contacts S3A and diode A2CR1 to energize relay K1. Removal of the negative voltage fed to A2R7 will release relay K1.

4.7 θ-Drive Relay Circuit

The normally open B contacts of θ-drive relay K3 are connected to the θ armature contactor (K4) in the PC-4A Positioner Control Unit when operating in a programmed mode. Energization of K4 causes the armature power supply in the positioner control unit to be connected to the θ drive motor. Release of K4 disconnects the armature supply voltage and connects a resistor to the drive-motor armature for dynamic braking.

The normally open B contacts of relay K3 are connected to the θ (elevation) armature contactor (K3) in the PC-4D Positioner Control Unit. This contactor switches the θ drive-motor armature between the armature supply and a dynamic-braking resistor.

When the ϕ-θ bistable multivibrator is in the θ state, the negative voltage appearing on the collector of A1Q11 is fed through the A contacts of relay K2 to A2R4 to cause θ-drive relay K3 to be energized. A time delay is provided by an integrating network (A2C3-A2R4-A2R5) to allow the forward-reverse contactor in the PC-4A Positioner Control Unit to operate before switching the armature supply

from the ϕ to the θ drive motor. Diodes A2CR2 and A2CR3 are connected in the integrating circuit to provide a sufficient time delay for energizing K3 but a much shorter time delay for releasing K3. The short release delay results from charging integrating capacitor A2C3 through A2CR2. The longer pull-in delay results from discharging A2C3 through A2CR3 and the high source resistance formed by A2R4 and A2R5. The normally closed A contacts of relay K2 prevent θ-drive relay K3 from being energized when ϕ-drive relay K2 is energized.

When the θ MODE switch is in a SEMI-AUTO position, θ ADVANCE switch S6 must be pressed to connect contact K3B to the positioner control unit. The θ ADVANCE switch must be held depressed until the positioner has advanced in θ and power is transferred to the ϕ axis.

4.8 ϕ-Drive Relay Circuit

ϕ-drive relay K2 operates contactors in the PC-4A or PC-4D Positioner Control Unit in a manner similar to that described for the θ-drive relay in paragraph 4.7. Energization of K2 will cause the positioner ϕ drive motor to run.

Relay K2 is energized when both transistors A2Q3 and A2Q4 are cut off. When these transistors are cut off, the negative collector voltage is fed through the normally closed A contacts of relay K3 to an integrator and relay driver similar to the one described in paragraph 4.7. A time delay is provided to allow the forward-reverse contactor in the positioner control unit to operate before connecting the armature power supply to the ϕ drive motor. The time delay for releasing K2 is much shorter than the time delay for energizing K2. The short de-energization time delay allows braking of the ϕ drive motor to occur within a fraction of a second after the ϕ set point has been reached.

Relay K2 is energized by the voltage from the collector of A1Q11 cutting off A2Q4 when the ϕ-θ bistable multivibrator is in the ϕ state. The negative voltage appearing on the collector of A2Q4 is fed through the normally closed A contacts of relay K3 to prevent K2 from being energized when K3 is energized.

Transistor A2Q3 is biased beyond cutoff. When the ϕ sector-scan bistable multivibrator switches to the reverse state, A1Q13 cuts off. The negative-going pulse

appearing at the collector of A1Q13 is differentiated by A2C2 and the parallel combination of A2R2 and A2R3 to turn on A2Q3. A delay of approximately 200 ms occurs before A2Q3 returns to its normally non-conducting state to allow time for ϕ-drive relay K2 to release. The ϕ integrator and relay driver provide an additional delay of approximately one second before energizing K2 to reapply power to the ϕ drive motor.

4.9 Start-Stop and Interlock Circuits

The program is begun by moving the POWER switch to the PROGRAM position and pressing the PROGRAM START button (S7). Relay K4 is energized through S7 and held energized by its A contacts to apply power to the circuits of the ϕ- and θ-drive relays (K2 and K3). The program is stopped by pressing the PROGRAM STOP button (S5) which de-energizes K4. When operating with a Model RDP-1801 Radiation Distribution Printer, K4 is returned to ground through the program interlock circuit in the RDP-1801. Operation of either the ϕ-start or scan-speed interlock circuit in the RDP-1801 opens the return to K4 to interrupt the program. When operating without a Model RDP-1801, K4 is returned to ground through a jumper on terminal board TB1.

4.10 Power Supply

Line voltage for the programmer power supply is obtained from the synchro-excitation supply for torque receivers B1 and B2. The power supply furnishes unregulated -24v dc for operation of the relays and set-point indicator lights. An unregulated 10v dc supply feeds lamps DS8 through DS13 which illuminate the phototransistors. Regulated -11v dc and +6v dc supplies feed the remaining transistor circuitry in the programmer. Regulation is obtained by use of two Zener diodes, CR5 and CR6. The nominal tolerances are held to within ±5% for the -11-volt supply and 6.2v ±10% for the +6-volt supply.

Lamps RT1 and RT2 serve as ballast resistors to reduce the current variations through the Zener diodes for changes in line voltage.

SECTION 5
ADJUSTMENTS AND MAINTENANCE

5.1 Adjustments

The only adjustments necessary are those that may be required to the synchro receivers and lamp-phototransistor assemblies in the θ-increment detector and ϕ set-point detector.

CAUTION

> Line voltage is present on the terminals of both synchro receivers, regardless of the POWER switch position. Remove the cable to J1 to disable the synchros.

The synchro receiver in the θ-increment detector is zeroed so that, at 0° θ orientation of the positioner, the light-chopper disk is positioned as shown in Fig. 5.1. To properly orient the synchro receiver set the positioner to 0° in θ; energize the synchro system and loosen the hold-down buttons securing the synchro (B1). Rotate the body as required to properly line up the holes in the disk with the light source. Tighten the synchro.

The lamps and phototransistors in the θ-increment detector must be positioned so that the maximum light falls on the phototransistors whenever a translucent portion of the disk is in position. Fig. 5.1 shows the correct illumination pattern.

The ϕ set-point detector is zeroed as follows: Rotate the positioner about the ϕ axis until it is oriented at its zero position. (Note that the synchro receiver rotation is clockwise for reverse ϕ rotation.)

Slowly rotate the ϕ REVERSE SET POINT control clockwise until the ϕ REVERSE lamp turns on. If the pointer does not read 0, loosen the setscrews in the knob and turn it to 0.

Rotate the ϕ FORWARD SET POINT control counterclockwise until the ϕ FORWARD

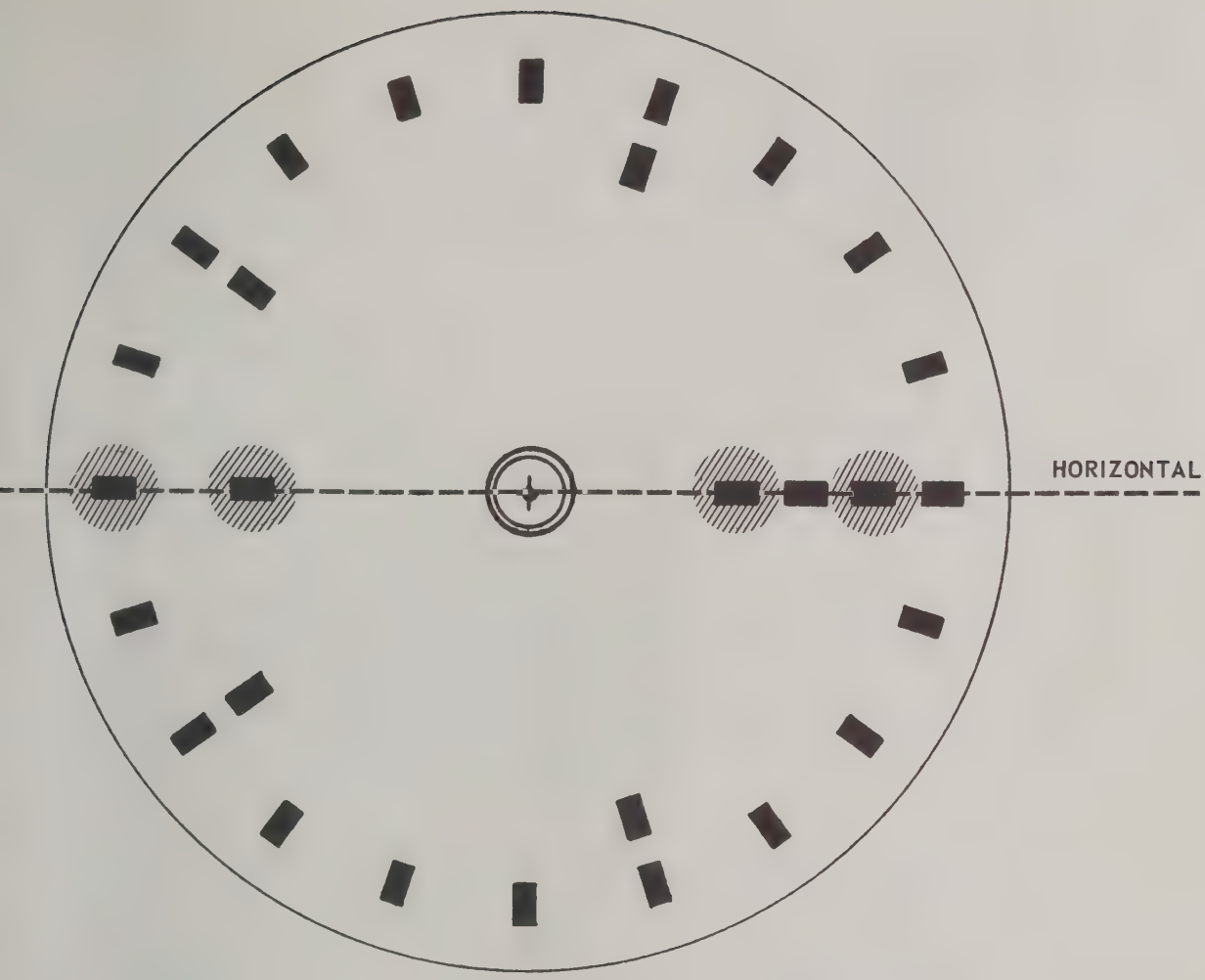


Fig. 5.1. θ Increment Detector Light-Chopper Disk Shown in the θ=0° Position. The Disk is Shown From the Light Source Side. The Shaded Areas Represent the Proper Illumination Patterns.

lamp lights. If necessary, adjust this knob until the pointer reads zero.

An alternate method for zeroing the ϕ set-point detector is to rotate the synchro receiver (B2) or change the coupling between the gears of the ϕ set-point detector. The position of the phototransistors and lamps relative to the shaft stop should not be changed to avoid excessive twisting of the leads connecting to this assembly.

5.2 Maintenance

Should a malfunction occur in the operation of the equipment, a visual check of all cables, connectors, relays, and switches should be made. Particular attention should be paid to the pattern of relay operation (refer to Fig. 4.1).

If the filament of any of the SET POINT indicators opens, the lamp must be replaced; trigger pulses for operation of the ϕ-θ and ϕ sector-scan bistable multivibrators are derived from across the lamp filaments. To change the lamp, unscrew the colored cap of the indicator and pull the lamp from the cap. The cap is crimped slightly to secure the lamp.

When replacing a lamp in one of the detector assemblies, replace with one whose glass envelope has good axial alignment with the lamp base. A lamp with a crooked envelope may direct its light off the phototransistor-lamp axis so that the illumination level on the phototransistor is insufficient for proper operation.

Four test points are provided to measure the voltages in the power supply. They are located at the left side of the main chassis. The voltage of the -24-volt supply, measured at TP4, should be between -24 and -28v dc. The voltage of the -11-volt supply, measured at TP3, should be between -10.95 and -11.55v dc. The voltage of the +6-volt supply, measured at TP1, should be between +5.58 and +6.82v dc.

5.3 Parts Location

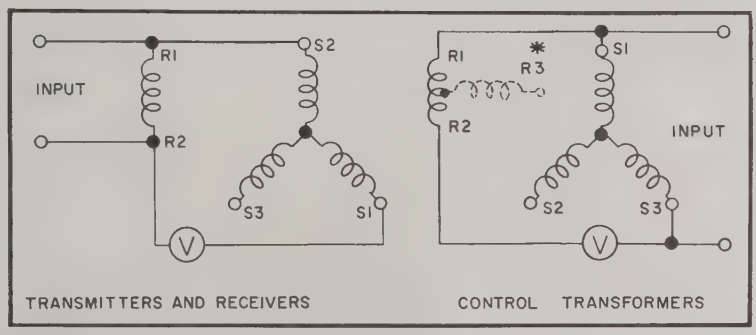
Many of the component-designation numbers are stamped on the chassis. Those components that are mounted on phenolic boards (plug-in or fixed) can be easily located with the drawings following Section 6.

SYNCHRO ELECTRICAL ZERO

The electrical zero of a synchro is defined as that position of the rotor, with respect to the stator, where the voltage between S1 and S3 is zero and where the voltage from S2 to S1 is in phase with the voltage from R1 to R2.

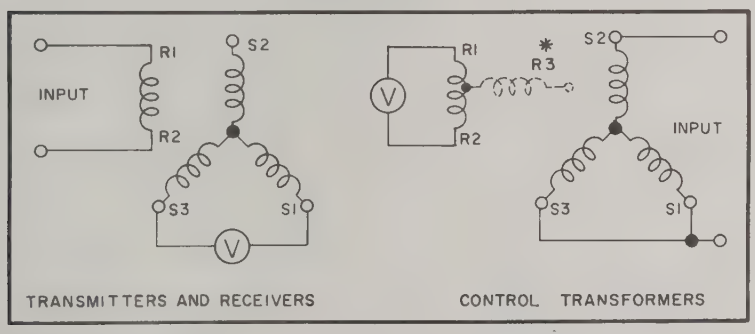
There are two null positions for any synchro. For the correct null, connect the synchro to a voltage source and voltmeter as shown in (A) below; then turn the rotor to determine coarse zero. As the rotor is turned, one null point near the correct electrical zero will be found. To determine the fine electrical zero, connect the synchro as shown in (B) and adjust the rotor slightly until a null is established. This is the exact electrical zero.

(A) COARSE ZERO



*WHEN CDX IS USED AS CT IN S-A TWO-SPEED SYNCHRO PEDESTAL SYSTEMS.

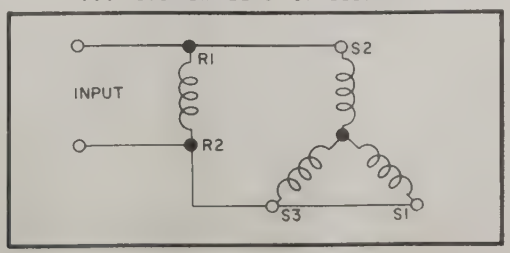
(B) FINE ZERO



*WHEN CDX IS USED AS CT IN S-A TWO-SPEED SYNCHRO PEDESTAL SYSTEMS.

To zero a synchro receiver when its shaft can rotate freely (as in a position indicator), remove all leads from the synchro and reconnect them as shown in (C). The synchro shaft will turn to the electrical zero position when rotor voltage is applied. Do not leave the synchro connected in this manner for more than two minutes, because the synchro will overheat.

(C) RECEIVER ZERO BY ELECTRICAL LOCK



SECTION 6

PARTS LIST

MODEL PCP-2004
POSITIONER PROGRAMMER

MANUFACTURERS' CODE LETTERS

Code	Manufacturer
A	Aerovox
AB	Allen-Bradley
ABE	Amphenol-Borg
AE	Amperex
BA	Bendix Aviation (Montrose Div.)
BC	Barber-Coleman
CD	Cornell-Dubilier
CML	Chicago Miniature Lamp Works
CRL	Centralab
DI	Dialight
G	Grayhill
GE	General Electric
HC	Hoffman Electronics
J	E. F. Johnson
L	Littelfuse
MH	Minneapolis-Honeywell
O	Ohmite (LD = Little Devil)
PB	Potter & Brumfield
SA	Scientific-Atlanta
T	Sarkes Tarzian
TT	Triad
WEC	Webster Electronics

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER

Component Designation	Description	Mfr.*	Mfr. Part No.
A1	Plug-in component board	SA	PCP4A1
A2	Plug-in component board	SA	PCP4A2
B1 B2	Synchro, receiver	BA	23TR6
**B3	Fan (motor and blade), 115v, 60 cps	BC	DYAB 569-116 and YAB 355-2
C1 thru C4	Capacitor, fixed, electrolytic, 500 μf, 50v dc	CD	BR500-50
C5 C6	Capacitor, fixed, electrolytic, 25 μf, 25v dc	A	PWE25025
CR1 thru CR4 CR7	Diode, silicon, 600 PIV, 0.75a	T	1N2484 (F-6)
CR5	Diode, Zener, 11v, 10w	HC	1N1352A

*See "MANUFACTURERS' CODE LETTERS."
**Serial number 6 and above.

PARTS LIST

MODEL PCP-2004
POSITIONER PROGRAMMER - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
CR6	Diode, Zener, 6.2v, 1w	HC	1N1766
CR7	See CR1		
DS1	Bulb, neon glow, 1/15w	CML	NE-2D
DS2 DS3 DS4 DS7	Bulb, incandescent, 28v, 40 ma	GE	327
DS5 DS6	Unassigned		
DS7	See DS2		
DS8 thru DS13	Bulb, incandescent, 2.5v, 350 ma	GE	253
F1	Fuse, 1a, 125v, 3AG slow-blow	L	313001
J1	Connector, male, 8-pin	ABE	MS3102A-20-7P

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
J2	Connector, female, 8-contact	ABE	MS3102A-20-7S(W)
J3	Connector, male, 17-pin	ABE	MS3102A-20-29P
J4	Connector, male, 10-pin	ABE	MS3102A-18-19P
J5	Connector, male, 2-pin	ABE	MS3102A-12S-3P
J6 J7	Connector, printed circuit, female, 22-contact	ABE	143-022-01
K1 K4	Relay, DPDT, 24v	PB	KRP11D
K2 K3	Relay, 3PDT, 24v	PB	KRP14D
K4	See K1		
P1	Connector, female, 8-contact	ABE	MS3106A-20-7S
P2	Connector, male, 8-pin	ABE	MS3106A-20-7P(W)
P3	Connector, female, 17-contact	ABE	MS3106A-20-29S
P4	Connector, female, 10-contact	ABE	MS3106A-18-19S
P5	Connector, female, 2-contact	ABE	MS3106A-12S-3S

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
Q1 thru Q6	Phototransistor, germanium, PNP	AE	OCP70
Q7 Q8 Q9	Transistor, germanium, PNP	MH	2N1501
R1 thru R6	Resistor, fixed, composition, 680 ohms ±10%, 1/4w	O	LD
R7	Resistor, fixed, composition, 680 ohms ±10%, 1w	O	LD
RT1 RT2	Bulb, ballast, 28v, 170 ma	GE	313
S1	Switch, rotary, ceramic, 2-section, 10-pole, with line switch	CRL	PA-024-5439
S2 S4	Switch, rotary, ceramic, 1-section, 3-pole	CRL	PA-2006
S3	Switch, rotary, ceramic, 1-section, 5-pole	CRL	PA-2015

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
S4	See S2		
S5	Switch, pushbutton, SPST, NC	G	4002
S6	Switch, pushbutton, SPST	G	4001
T1	Transformer, low-voltage rectifier, 115v tapped pri., 10/20CT/40CT sec. @ 1a	TT	F-92A
TP1	Jack, pin, red	J	105-602
TP2	Jack, pin, black	J	105-603
TP3 TP4	Jack, pin, blue	J	105-605
XDS1	Light assembly	DI	137-8836-937
XDS2 XDS3 XDS4	Light assembly	DI	162-8430-933

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
XDS7	Light assembly	DI	162-8430-932
XDS8 XDS9	Light assembly	WEC	WE 775
XDS10 thru XDS13	Light assembly	WEC	WE 771
XF1	Fuse holder	L	HKP
XRT1 XRT2	Light socket	DI	2-06

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER

SUBASSEMBLY: COMPONENT BOARD A1

Component Designation	Description	Mfr.*	Mfr. Part No.
A1C1 A1C2 A1C3	Capacitor, fixed, Mylar, 0.01 μf, 100v	CD	WMF-1S1E
A1C4 A1C5	Capacitor, fixed, ceramic, 0.002 μf, 1000v	CRL	DD202
A1CR1 thru A1CR5	Diode, silicon, 600 PIV, 0.75a	T	1N2484 (F-6)
A1P1	Connector, printed circuit, male, 22-pin	ABE	133-022-23
A1Q1 A1Q3 A1Q4 A1Q6 A1Q7 A1Q9 thru A1Q13	Transistor, germanium, PNP	GE	2N404A

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER

SUBASSEMBLY: COMPONENT BOARD A1 - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
A1Q2 A1Q5 A1Q8	Transistor, germanium, PNP	GE	2N404
A1Q3 A1Q4	See A1Q1		
A1Q5	See A1Q2		
A1Q6 A1Q7	See A1Q1		
A1Q8	See A1Q2		
A1Q9 thru A1Q13	See A1Q1		
A1R1 A1R2	Resistor, fixed, composition, 1800 ohms ±10%, 1/2w	AB	EB-1821
A1R3 A1R21 A1R23 A1R25	Resistor, fixed, composition, 3300 ohms ±10%, 1/2w	AB	EB-3321
A1R4 A1R8	Resistor, fixed, composition, 5600 ohms ±10%, 1/2w	AB	EB-5621

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER

SUBASSEMBLY: COMPONENT BOARD A1 - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
A1R5 A1R9 A1R12 A1R18 A1R19 A1R20 A1R33 A1R37 A1R41 A1R44	Resistor, fixed, composition, 1000 ohms ±10%, 1/2w	AB	EB-1021
A1R6 A1R10 A1R16	Resistor, fixed, composition, 8200 ohms ±10%, 1/2w	AB	EB-8221
A1R7 A1R11 A1R13	Resistor, fixed, composition, 470 ohms ±10%, 1/2w	AB	EB-4711
A1R8	See A1R4		
A1R9	See A1R5		
A1R10	See A1R6		
A1R11	See A1R7		
A1R12	See A1R5		
A1R13	See A1R7		
A1R14 A1R15 A1R17	Resistor, fixed, composition, 15,000 ohms ±10%, 1/2w	AB	EB-1531
A1R16	See A1R6		
A1R17	See A1R14		

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER

SUBASSEMBLY: COMPONENT BOARD A1 - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
A1R18 A1R19 A1R20	See A1R5		
A1R21	See A1R3		
A1R22 A1R24 A1R26 A1R35 A1R39 A1R42 A1R45	Resistor, fixed, composition, 12,000 ohms ±10%, 1/2w	AB	EB-1221
A1R23	See A1R3		
A1R24	See A1R22		
A1R25	See A1R21		
A1R26	See A1R22		
A1R27 A1R29 A1R31	Resistor, fixed, composition, 1000 ohms ±10%, 1w	AB	GB-1021
A1R28 A1R30 A1R32 A1R50 A1R51 A1R52	Resistor, fixed, composition, 82,000 ohms ±10%, 1/2w	AB	EB-8231
A1R29	See A1R27		
A1R30	See A1R28		
A1R31	See A1R27		

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER

SUBASSEMBLY: COMPONENT BOARD A1 - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
A1R32	See A1R28		
A1R33	See A1R5		
A1R34 A1R38	Resistor, fixed, composition, 10,000 ohms ±10%, 1/2w	AB	EB-1031
A1R35	See A1R22		
A1R36 A1R40 A1R43 A1R46	Resistor, fixed, composition, 22,000 ohms ±10%, 1/2w	AB	EB-2231
A1R37	See A1R5		
A1R38	See A1R34		
A1R39	See A1R22		
A1R40	See A1R36		
A1R41	See A1R5		
A1R42	See A1R22		
A1R43	See A1R36		
A1R44	See A1R5		
A1R45	See A1R22		
A1R46	See A1R36		
A1R47 A1R48 A1R49	Resistor, fixed, composition, 390 ohms ±10%, 1/2w	AB	EB-3911
A1R50 A1R51 A1R52	See A1R28		

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER

SUBASSEMBLY: COMPONENT BOARD A2

Component Designation	Description	Mfr.*	Mfr. Part No.
A2C1 A2C3	Capacitor, fixed, electrolytic, 10 µf, 50v dc	A	PWE50010
A2C2	Capacitor, fixed, electrolytic, 25 µf, 25v dc	A	PWE25025
A2C3	See A2C1		
A2C4	Capacitor, fixed, electrolytic, 25 µf, 50v dc	CD	NLW 25-50
A2CR1 thru A2CR6	Diode, silicon, 600 PIV, 0.75 ma	T	1N2484 (F-6)
A2P1	Connector, printed circuit, male, 22-pin	ABE	133-022-03
A2Q1 A2Q4 A2Q5 A2Q7	Transistor, germanium, PNP	GE	2N404

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

MODEL PCP-2004

POSITIONER PROGRAMMER

SUBASSEMBLY: COMPONENT BOARD A2 - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
A2Q2	Unassigned		
A2Q3	Transistor, germanium, PNP	GE	2N404A
A2Q4 A2Q5	See A2Q1		
A2Q6	Unassigned		
A2Q7	See A2Q1		
A2R1 A2R3 A2R4 A2R7 A2R16	Resistor, fixed, composition, 10,000 ohms ±10%, 1/2w	AB	EB-1031
A2R2 A2R5 A2R8 A2R12 A2R17	Resistor, fixed, composition, 22,000 ohms ±10%, 1/2w	AB	EB-2231
A2R3 A2R4	See A2R1		
A2R5	See A2R2		
A2R6 A2R9 A2R10 A2R13 A2R15 A2R18 A2R19	Resistor, fixed, composition, 1000 ohms ±10%, 1/2w	AB	EB-1021

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

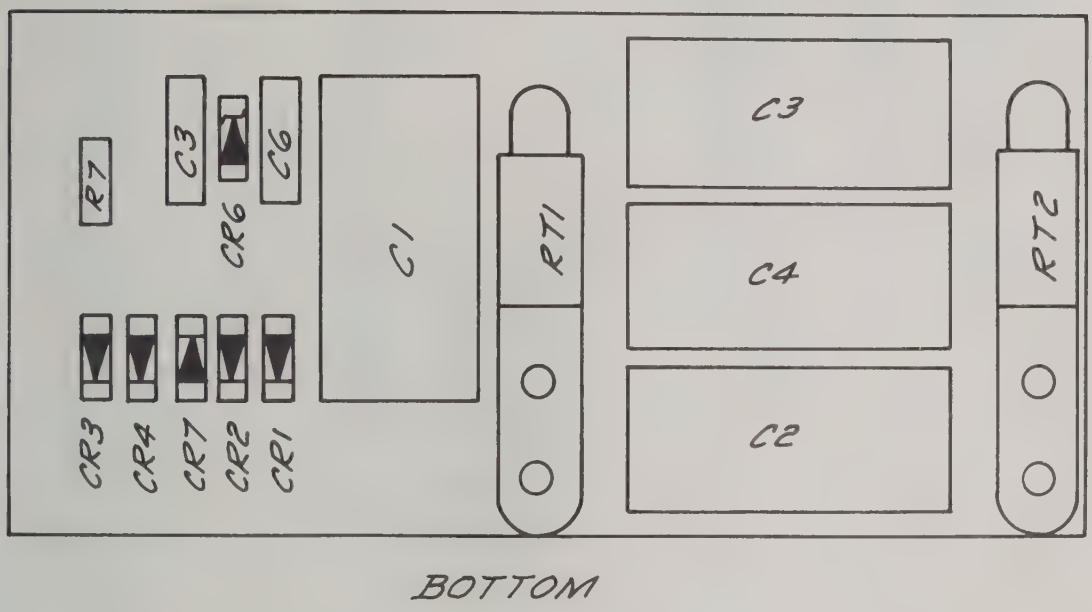
MODEL PCP-2004

POSITIONER PROGRAMMER

SUBASSEMBLY: COMPONENT BOARD A2 - continued

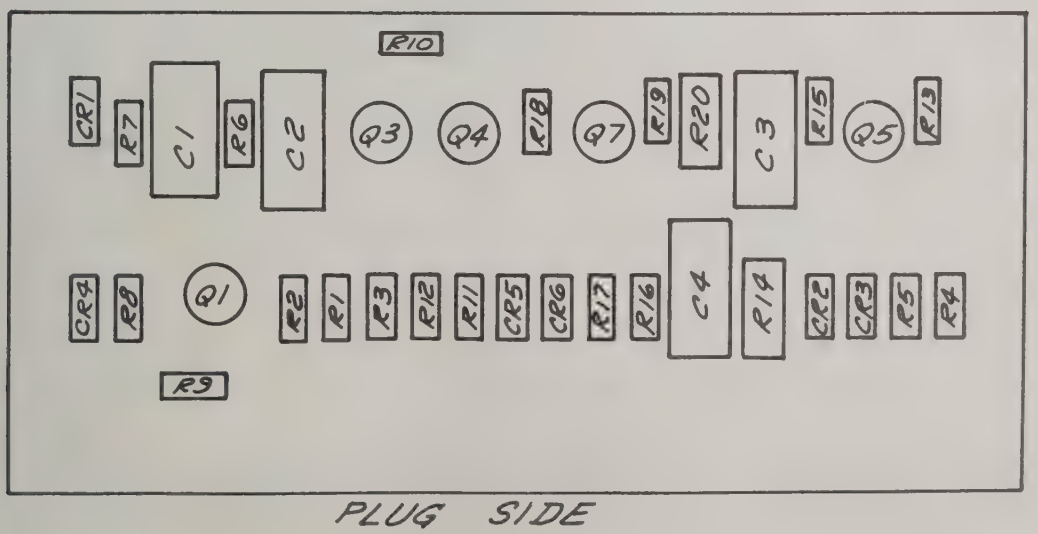
Component Designation	Description	Mfr.*	Mfr. Part No.
A2R7	See A2R1		
A2R8	See A2R2		
A2R9 A2R10	See A2R6		
A2R11	Resistor, fixed, composition, 12,000 ohms ±10%, 1/2w	AB	EB-1231
A2R12	See A2R2		
A2R13	See A2R6		
A2R14 A2R20	Resistor, fixed, composition, 1000 ohms ±10%, 1w	AB	GB-1021
A2R15	See A2R6		
A2R16	See A2R1		
A2R17	See A2R2		
A2R18 A2R19	See A2R6		
A2R20	See A2R14		

*See "MANUFACTURERS' CODE LETTERS."

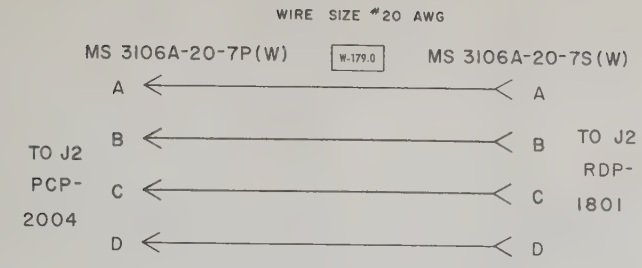


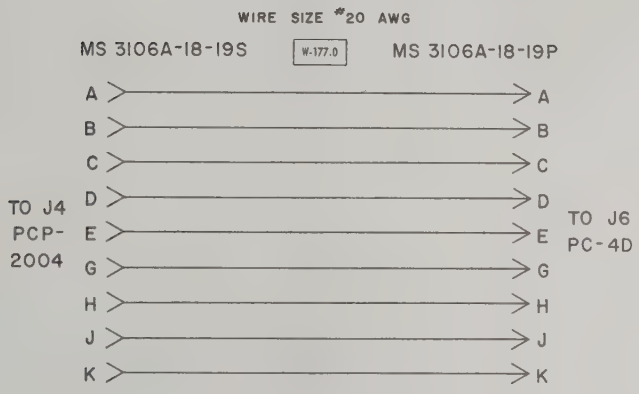
Component Board Located at Left-Rear of Chassis

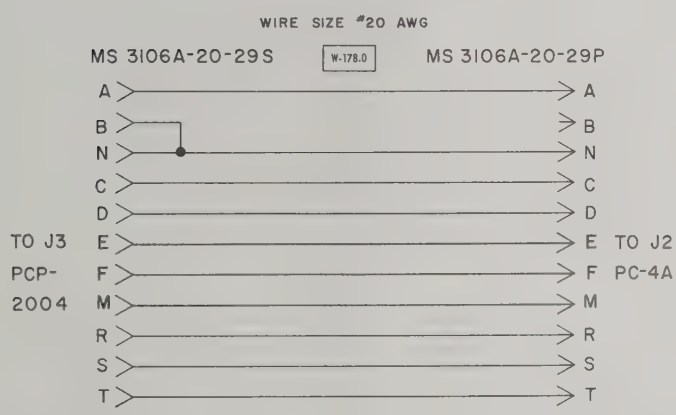
Plug-In Card A1



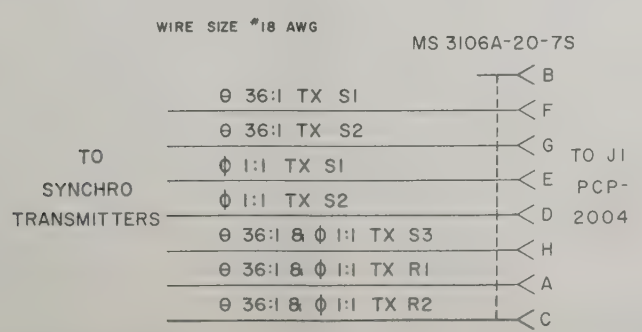
Plug-In Card A2



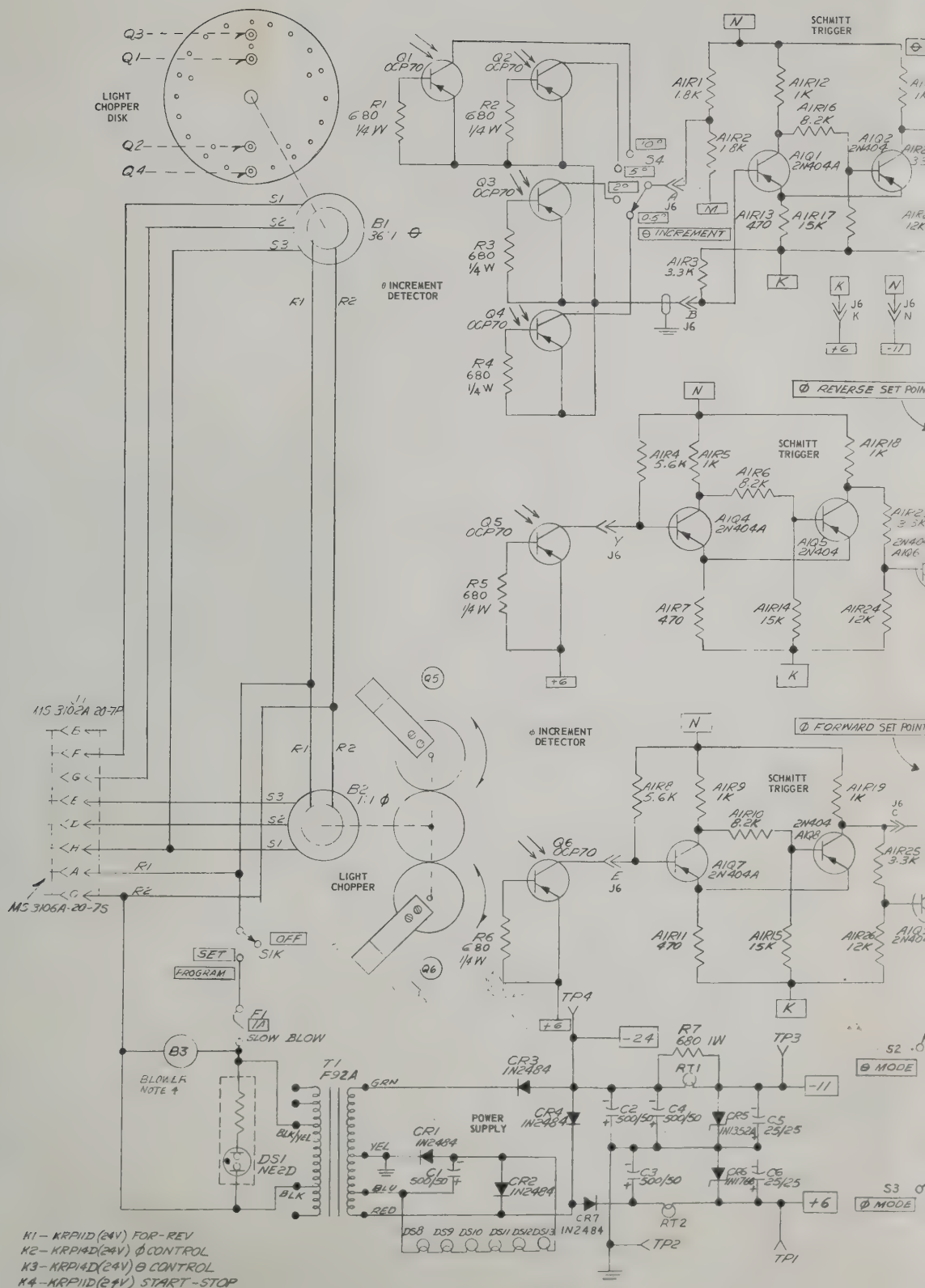


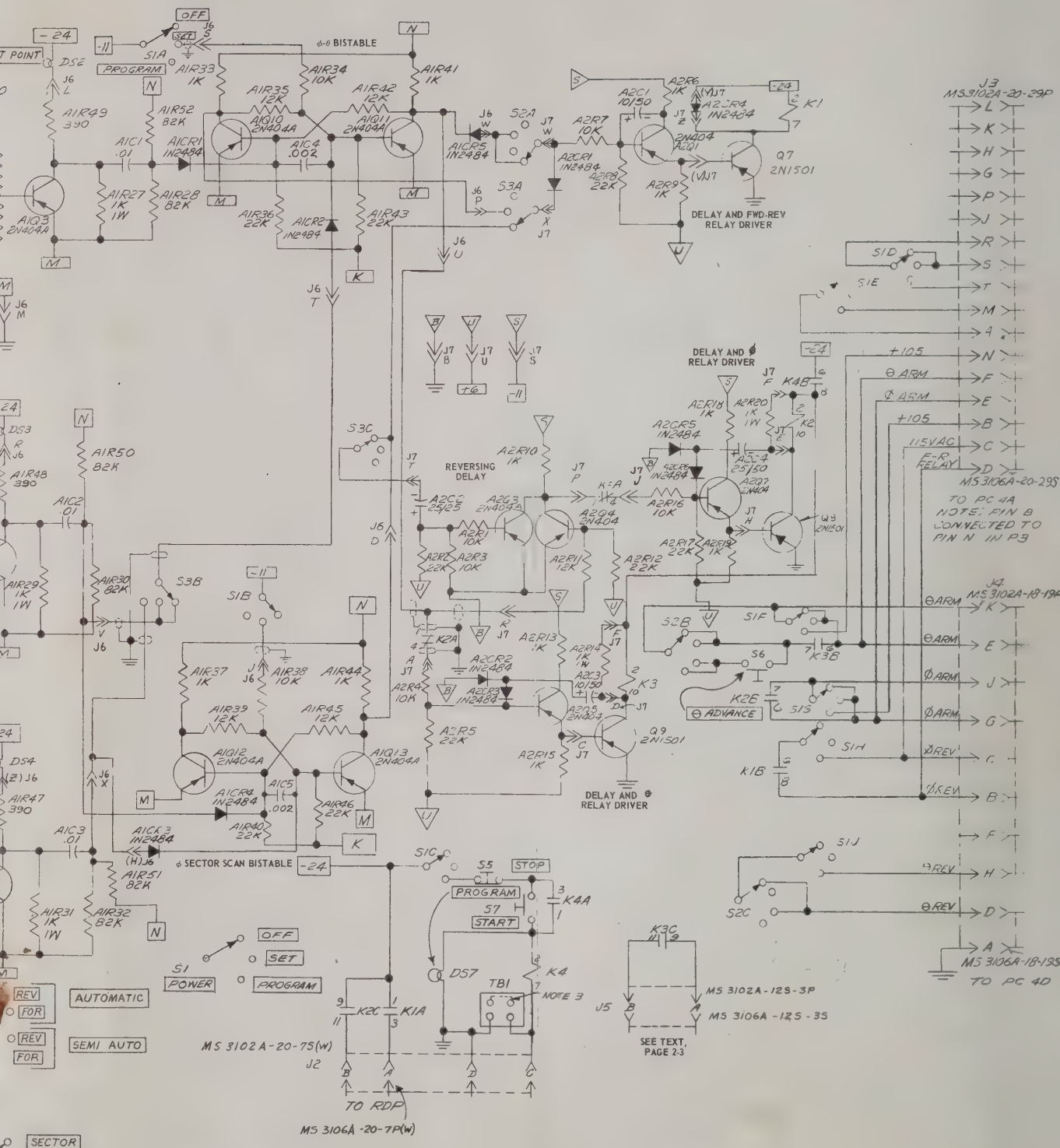


Schematic Diagrams of Interconnecting Cables



Schematic Diagram of Synchro Input Cable. Note That the S1 and S3 Connections of Synchro B2 are Connected to the S3 and S1 Terminals, Respectively, of the ϕ-1:1 Synchro Transmitter


LIGHT CHOPPER DISK
Q3
Q1
Q2
Q4
S1
S2
S3
B1 36:1 θ
θ INCREMENT DETECTOR
R1
R2
Q1 OCP70
Q2 OCP70
Q3 OCP70
Q4 OCP70
R1 680 1/4 W
R2 680 1/4 W
R3 680 1/4 W
R4 680 1/4 W
SCHMITT TRIGGER
AIR1 1.8K
AIR12 1K
AIR16 8.2K
AIR2 1.8K
AIQ1 2N404A
AIQ2 2N404
AIR13 470
AIR17 15K
AIR3 3.3K
θ INCREMENT
Q5 OCP70
R5 680 1/4 W
Ø REVERSE SET POINT
AIR4 5.6K
AIR5 1K
AIR6 8.2K
AIR18 1K
AIQ4 2N404A
AIQ5 2N404
AIR7 470
AIR14 15K
AIR24 12K
115 3102A 20-7P
MS 3106A-20-7S
Q5
Q6
B2 7:1 Ø
LIGHT CHOPPER
Ø INCREMENT DETECTOR
Ø FORWARD SET POINT
AIR8 5.6K
AIR9 1K
AIR19 1K
AIR10 8.2K
AIQ7 2N404A
AIR11 470
AIR15 15K
AIR25 3.3K
AIR26 12K
Q6 OCP70
R6 680 1/4 W
OFF
S1K
SET PROGRAM
F1 1A SLOW BLOW
B3 BLOWER NOTE 4
T1 F92A
DS1 NE2D
POWER SUPPLY
CR1 IN2484
CR2 IN2484
CR3 IN2484
CR4 IN2484
CR7 IN2484
C1 500/50
C2 500/50
C3 500/50
C4 500/50
C5 25/25
C6 25/25
CR5 IN1352A
CR6 IN1346
R7 680 1W
RT1
RT2
TP1
TP2
TP3
TP4
S2 θ MODE
S3 Ø MODE
DS8 DS9 DS10 DS11 DS12 DS13
K1 – KRP11D (24V) FOR-REV
K2 – KRP14D (24V) Ø CONTROL
K3 – KRP14D (24V) θ CONTROL
K4 – KRP11D (24V) START-STOP



NOTE

1. ALL RESISTORS IN OHMS, 10% & ½ WATT UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. ADD JUMPER TO TB1 WHEN NOT USED WITH RDP.
4. SERIAL NO. 6 & ABOVE.

Schematic Diagram of Model PCP-2004 Positioner Programmer

CONVERSION OF VOLTAGE AND POWER RATIOS TO DECIBELS

The basic chart below indicates the number of decibels (dB) corresponding to the listed ratios of voltage or power over the range of −20 to +20 dB. For voltage or power ratios greater than those included in the chart, the ratio can be broken down into a product of two numbers, the value in dB for each found separately, and the two results added. Example: To convert a power ratio of 2,000:1 to dB, express 2,000 as 2×10^3; the number of dB corresponding to a power ratio of 2 is very nearly 3, and the number of dB for a power ratio of 10^3 is 30. Therefore, the power ratio of 2,000:1 is approximately 30 dB + 3 dB = 33 dB. In the lower righthand corner of the chart dB values for voltage and power ratios of integral powers of 10 are given.

Voltage Ratio	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*	*Voltage Ratio*	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*	*Voltage Ratio*	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*
1.000	**1.000**	**0**	**1.000**	**1.000**	**.447**	**.200**	**7.0**	**2.239**	**5.012**	**.200**	**.0398**	**14.0**	**5.012**	**25.12**
.989	.977	.1	1.012	1.023	.442	.195	7.1	2.265	5.129	.197	.0389	14.1	5.070	25.70
.977	.955	.2	1.023	1.047	.437	.191	7.2	2.291	5.248	.195	.0380	14.2	5.129	26.30
.966	.933	.3	1.035	1.072	.432	.186	7.3	2.317	5.370	.193	.0372	14.3	5.188	26.92
.955	.912	.4	1.047	1.096	.427	.182	7.4	2.344	5.495	.191	.0363	14.4	5.248	27.54
.944	.891	.5	1.059	1.122	.422	.178	7.5	2.371	5.623	.188	.0355	14.5	5.309	28.18
.933	.871	.6	1.072	1.148	.417	.174	7.6	2.399	5.754	.186	.0347	14.6	5.370	28.84
.923	.851	.7	1.084	1.175	.412	.170	7.7	2.427	5.888	.184	.0339	14.7	5.433	29.51
.912	.832	.8	1.096	1.202	.407	.166	7.8	2.455	6.026	.182	.0331	14.8	5.495	30.20
.902	.813	.9	1.109	1.230	.403	.162	7.9	2.483	6.166	.180	.0324	14.9	5.559	30.90
.891	**.794**	**1.0**	**1.122**	**1.259**	**.398**	**.159**	**8.0**	**2.512**	**6.310**	**.178**	**.0316**	**15.0**	**5.623**	**31.62**
.881	.776	1.1	1.135	1.288	.394	.155	8.1	2.541	6.457	.176	.0309	15.1	5.689	32.36
.871	.759	1.2	1.148	1.318	.389	.151	8.2	2.570	6.607	.174	.0302	15.2	5.754	33.11
.861	.741	1.3	1.161	1.349	.385	.148	8.3	2.600	6.761	.172	.0295	15.3	5.821	33.88
.851	.724	1.4	1.175	1.380	.380	.145	8.4	2.630	6.918	.170	.0288	15.4	5.888	34.67
.841	.708	1.5	1.189	1.413	.376	.141	8.5	2.661	7.079	.168	.0282	15.5	5.957	35.48
.832	.692	1.6	1.202	1.445	.372	.138	8.6	2.692	7.244	.166	.0275	15.6	6.026	36.31
.822	.676	1.7	1.216	1.479	.367	.135	8.7	2.723	7.413	.164	.0269	15.7	6.095	37.15
.813	.661	1.8	1.230	1.514	.363	.132	8.8	2.754	7.586	.162	.0263	15.8	6.166	38.02
.804	.646	1.9	1.245	1.549	.359	.129	8.9	2.786	7.762	.160	.0257	15.9	6.237	38.90
.794	**.631**	**2.0**	**1.259**	**1.585**	**.355**	**.126**	**9.0**	**2.818**	**7.943**	**.159**	**.0251**	**16.0**	**6.310**	**39.81**
.785	.617	2.1	1.274	1.622	.351	.123	9.1	2.851	8.128	.157	.0246	16.1	6.383	40.74
.776	.603	2.2	1.288	1.660	.347	.120	9.2	2.884	8.318	.155	.0240	16.2	6.457	41.69
.767	.589	2.3	1.303	1.698	.343	.118	9.3	2.917	8.511	.153	.0234	16.3	6.531	42.66
.759	.575	2.4	1.318	1.738	.339	.115	9.4	2.951	8.710	.151	.0229	16.4	6.607	43.65
.750	.562	2.5	1.334	1.778	.335	.112	9.5	2.985	8.913	.150	.0224	16.5	6.683	44.67
.741	.550	2.6	1.349	1.820	.331	.110	9.6	3.020	9.120	.148	.0219	16.6	6.761	45.71
.733	.537	2.7	1.365	1.862	.327	.107	9.7	3.055	9.333	.146	.0214	16.7	6.839	46.77
.724	.525	2.8	1.380	1.905	.324	.105	9.8	3.090	9.550	.145	.0209	16.8	6.918	47.86
.716	.513	2.9	1.396	1.950	.320	.102	9.9	3.126	9.772	.143	.0204	16.9	6.998	48.98
.708	**.501**	**3.0**	**1.413**	**1.995**	**.316**	**.100**	**10.0**	**3.162**	**10.000**	**.141**	**.0200**	**17.0**	**7.079**	**50.12**
.700	.490	3.1	1.429	2.042	.313	.0977	10.1	3.199	10.23	.140	.0195	17.1	7.161	51.29
.692	.479	3.2	1.445	2.089	.309	.0955	10.2	3.236	10.47	.138	.0191	17.2	7.244	52.48
.684	.468	3.3	1.462	2.138	.306	.0933	10.3	3.273	10.72	.137	.0186	17.3	7.328	53.70
.676	.457	3.4	1.479	2.188	.302	.0912	10.4	3.311	10.96	.135	.0182	17.4	7.413	54.95
.668	.447	3.5	1.496	2.239	.299	.0891	10.5	3.350	11.22	.133	.0178	17.5	7.499	56.23
.661	.437	3.6	1.514	2.291	.295	.0871	10.6	3.388	11.48	.132	.0174	17.6	7.586	57.54
.653	.427	3.7	1.531	2.344	.292	.0851	10.7	3.428	11.75	.130	.0170	17.7	7.674	58.88
.646	.417	3.8	1.549	2.399	.288	.0832	10.8	3.467	12.02	.129	.0166	17.8	7.762	60.26
.638	.407	3.9	1.567	2.455	.285	.0813	10.9	3.508	12.30	.127	.0162	17.9	7.852	61.66
.631	**.398**	**4.0**	**1.585**	**2.512**	**.282**	**.0794**	**11.0**	**3.548**	**12.59**	**.126**	**.0159**	**18.0**	**7.943**	**63.10**
.624	.389	4.1	1.603	2.570	.279	.0776	11.1	3.589	12.88	.125	.0155	18.1	8.035	64.57
.617	.380	4.2	1.622	2.630	.275	.0759	11.2	3.631	13.18	.123	.0151	18.2	8.128	66.07
.610	.372	4.3	1.641	2.692	.272	.0741	11.3	3.673	13.49	.122	.0148	18.3	8.222	67.61
.603	.363	4.4	1.660	2.754	.269	.0724	11.4	3.715	13.80	.120	.0145	18.4	8.318	69.18
.596	.355	4.5	1.679	2.818	.266	.0708	11.5	3.758	14.13	.119	.0141	18.5	8.414	70.79
.589	.347	4.6	1.698	2.884	.263	.0692	11.6	3.802	14.45	.118	.0138	18.6	8.511	72.44
.582	.339	4.7	1.718	2.951	.260	.0676	11.7	3.846	14.79	.116	.0135	18.7	8.610	74.13
.575	.331	4.8	1.738	3.020	.257	.0661	11.8	3.890	15.14	.115	.0132	18.8	8.710	75.86
.569	.324	4.9	1.758	3.090	.254	.0646	11.9	3.936	15.49	.114	.0129	18.9	8.811	77.62
.562	**.316**	**5.0**	**1.778**	**3.162**	**.251**	**.0631**	**12.0**	**3.981**	**15.85**	**.112**	**.0126**	**19.0**	**8.913**	**79.43**
.556	.309	5.1	1.799	3.236	.248	.0617	12.1	4.027	16.22	.111	.0123	19.1	9.016	81.28
.550	.302	5.2	1.820	3.311	.246	.0603	12.2	4.074	16.60	.110	.0120	19.2	9.120	83.18
.543	.295	5.3	1.841	3.388	.243	.0589	12.3	4.121	16.98	.108	.0118	19.3	9.226	85.11
.537	.288	5.4	1.862	3.467	.240	.0575	12.4	4.169	17.38	.107	.0115	19.4	9.333	87.10
.531	.282	5.5	1.884	3.548	.237	.0562	12.5	4.217	17.78	.106	.0112	19.5	9.441	89.13
.525	.275	5.6	1.905	3.631	.234	.0550	12.6	4.266	18.20	.105	.0110	19.6	9.550	91.20
.519	.269	5.7	1.928	3.715	.232	.0537	12.7	4.315	18.62	.104	.0107	19.7	9.661	93.33
.513	.263	5.8	1.950	3.802	.229	.0525	12.8	4.365	19.05	.102	.0105	19.8	9.772	95.50
.507	.257	5.9	1.972	3.890	.227	.0513	12.9	4.416	19.50	.101	.0102	19.9	9.886	97.72
.501	**.251**	**6.0**	**1.995**	**3.981**	**.224**	**.0501**	**13.0**	**4.467**	**19.95**	**.100**	**.0100**	**20.0**	**10.000**	**100.00**
.496	.246	6.1	2.018	4.074	.221	.0490	13.1	4.519	20.42		10^{-3}	30		10^3
.490	.240	6.2	2.042	4.169	.219	.0479	13.2	4.571	20.89	10^{-2}	10^{-4}	40	10^2	10^4
.484	.234	6.3	2.065	4.266	.216	.0468	13.3	4.624	21.38					
.479	.229	6.4	2.089	4.365	.214	.0457	13.4	4.677	21.88		10^{-5}	50		10^5
.473	.224	6.5	2.113	4.467	.211	.0447	13.5	4.732	22.39	10^{-3}	10^{-6}	60	10^3	10^6
.468	.219	6.6	2.138	4.571	.209	.0437	13.6	4.786	22.91		10^{-7}	70		10^7
.462	.214	6.7	2.163	4.677	.207	.0427	13.7	4.842	23.44	10^{-4}	10^{-8}	80	10^4	10^8
.457	.209	6.8	2.188	4.786	.204	.0417	13.8	4.898	23.99		10^{-9}	90		10^9
.452	.204	6.9	2.213	4.898	.202	.0407	13.9	4.955	24.55	10^{-5}	10^{-10}	100	10^5	10^{10}
											10^{-11}	110		10^{11}
										10^{-6}	10^{-12}	120	10^6	10^{12}

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